Space Weather Technical Forecast

Issued on Sunday, 03 April 2022 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: S1/Minor radiation storm declining to background. Slowly declining risk of further M-flares. Chance of G1/Minor Storm on Day 1 (03 Apr). Increasing risk of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the past 24 hours, with three M-flares, all from the region near the northwest limb where three sunspots are close together. There are now seven sunspot regions on the facing side of the sun, with the most active being a combination of AR2975, AR2984 and AR2976 near the northwest limb. Elsewhere on the disc, AR2981 and AR2978 near south centre disc showed some minor growth through the period. The remaining regions are small and simple, but there is a new region rotating onto the southeast limb which cannot yet be classified.
The long period M-flare which peaked around 02/1400 UTC gave a CME, but this is considered unlikely to have an Earth-directed component. No other Earth-directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, showed a likely CME arrival at 02/0020 UTC, this probably combined with a HSS from CH70 or CH71. The wind speed was initially around 490km/s, but jumped to vary between 530-590 km/s at 02/0020 UTC, before settling between 510-540 km/s. The density was initially at average levels, but jumped to just above average for much of the rest of the period. The IMF, Bt, was mainly weak but reached moderate levels between 02/0030-0300 UTC. The north-south component, Bz, varied between +9/-10nT at first, settling mainly south with peaks of -6nT after 02/0300 UTC. The phi angle was mainly negative (towards the Sun), but with some variation. Geomagnetic activity was Quiet to Active (Kp 2-4), with a G1/Minor Storm (Kp5) interval between 02/0300-0600 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 reached S1/Minor Storm levels at 02/1430 UTC, after an M-flare from the northwestern limb region. Proton flux levels have since declined, and are now around the S1 threshold.
The high energy (greater than 2MeV) electron flux as observed by GOES-16 at GEO was initially at Normal Background levels, rising to briefly peak at High levels (1180 pfu at 02/2005 UTC). The fluence was on a rising trend, reaching 2.23e7 integrated pfu at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-flares are likely through this period with a slight chance of X-flares. The risk reduces through the coming four days as the regions near the northwest limb rotate off the visible disc.

Solar Wind / Geomagnetic Activity: Earth is likely experiencing a CME influence, probably combined with some HSS influence from CH70 or 71. It seems likely that the associated elevated solar wind conditions will continue through much of Day 1 (03 Apr), before gradually

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easing into Day 2 (04 Apr). No further CME or coronal hole effects are currently expected through Days 3 and 4 (05-06 Apr), with solar winds forecast to be close to ambient levels. Geomagnetic activity is expected to be Quiet to Active (Kp 2-4) with a chance of G1/Minor Storm (Kp 5) intervals through Day 1, easing through Day 2, to become mostly Quiet through Days 3 and 4.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is currently around the S1/Minor Storm threshold after an earlier long period M-flare. This is expected to gradually decline to background levels during Day 1 (03 Apr). The risk of further proton storms will slowly reduce as the northwestern sunspot regions rotate well off the disc. The high energy (greater than 2 MeV) electron flux is expected to continue to increase through the next few days. It is probable that electron flux will reach High levels at the diurnal peaks. The associated 24-hour fluence will start below the Active (1e8 integrated pfu) threshold, but on a rising trend. Fluence is expected to continue to rise, with a chance that Active levels may be reached on Day 1 (03 Apr), becoming likely by Days 3 and 4 (05-06 Apr).

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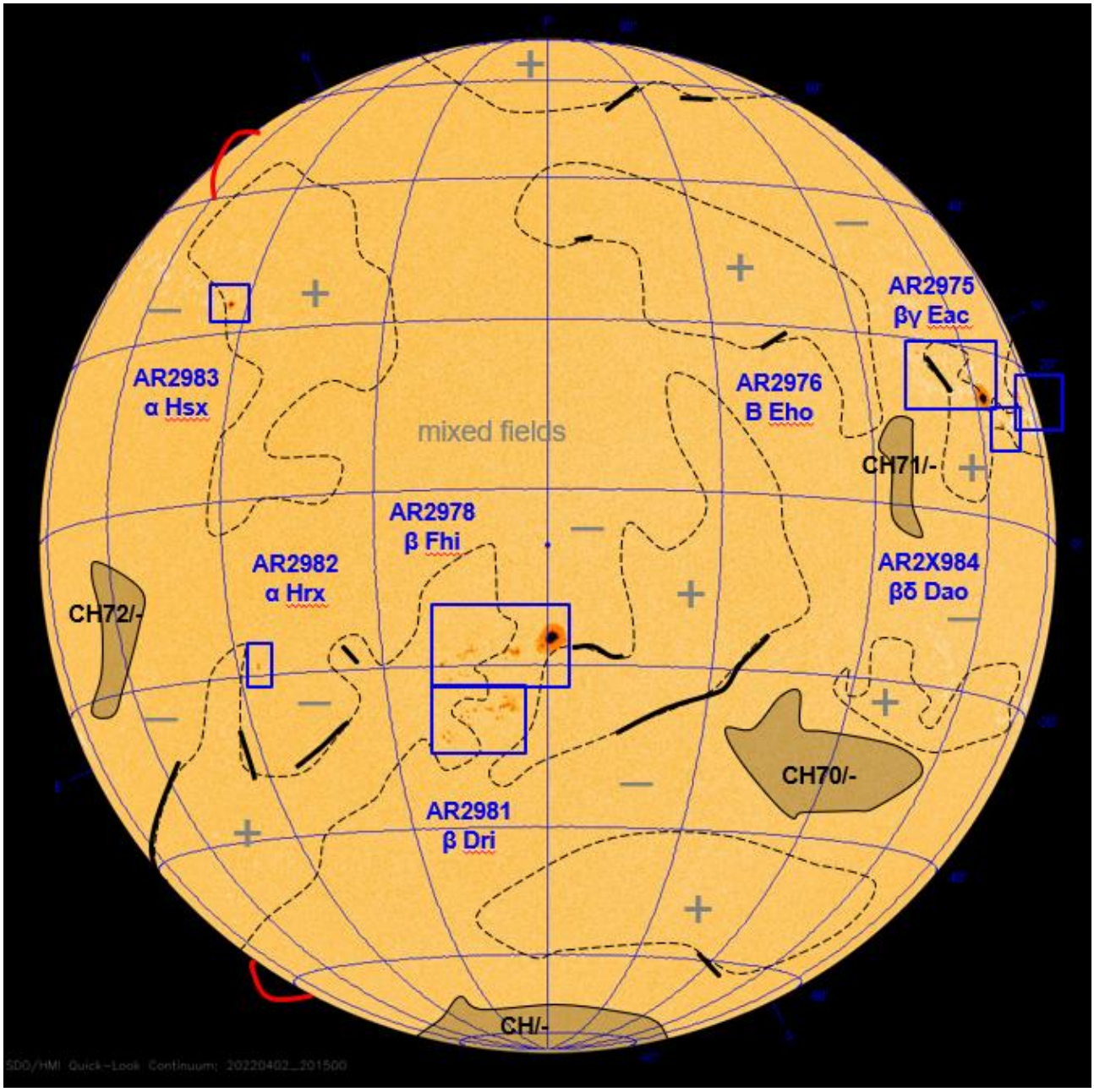
Figure 1. Solar Analysis Valid 02/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The solar wind recorded at L1 suggests that Earth is experiencing CME influence after an arrival at 02/0020 UTC, probably combined with some HSS influence from CH70 or 71. It seems likely that these conditions will continue through much of Day 1 (03 Apr), before gradually easing into Day 2 (04 Apr). No further CME or coronal hole effects are currently expected through Days 3 and 4 (05-06 Apr), with solar winds forecast to be close to ambient levels.
Geomagnetic activity is expected to be Quiet to Active (Kp 2-4) with a chance of G1/Minor Storm (Kp 5) intervals through Day 1, easing through Day 2, to become mostly Quiet through Days 3 and 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	40	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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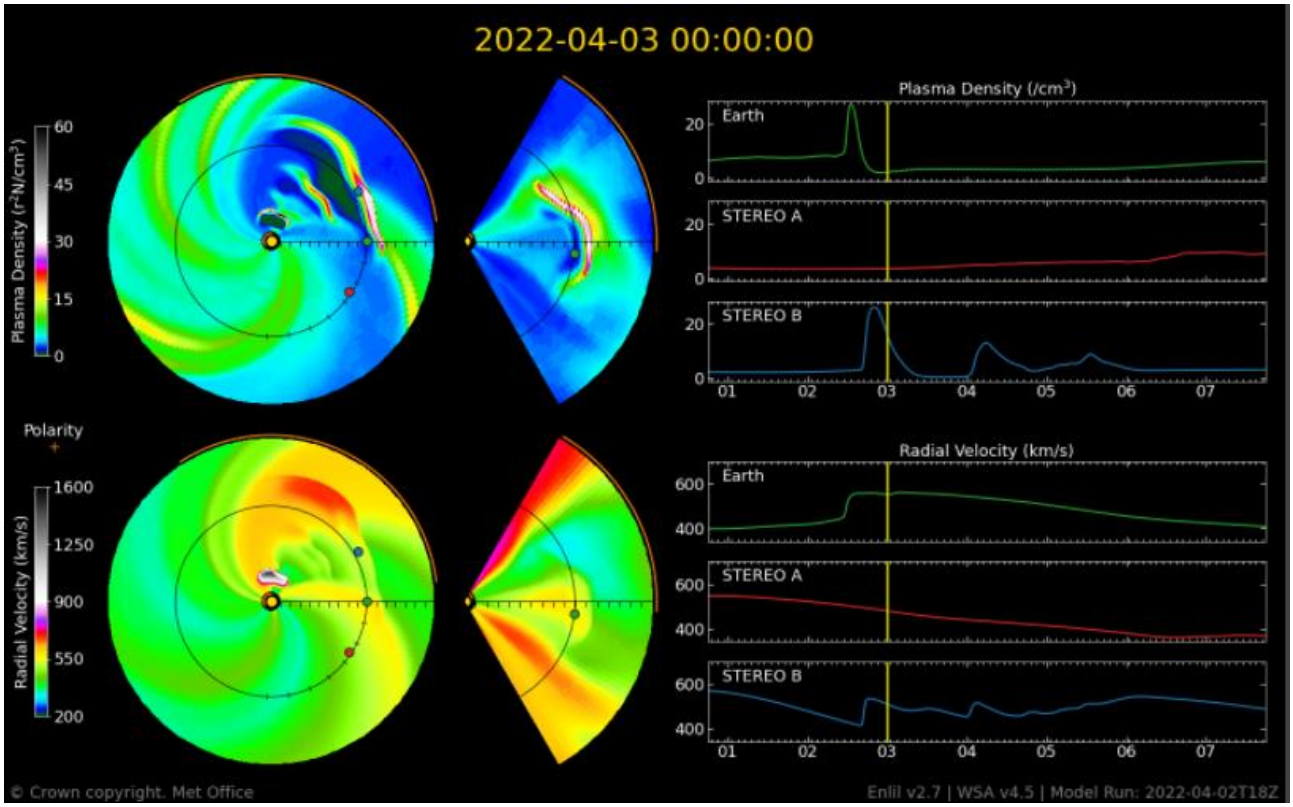
Figure 2: Enlil model showing a slow decline in solar wind speeds. Enlil may be a little too slow to reduce wind speeds.



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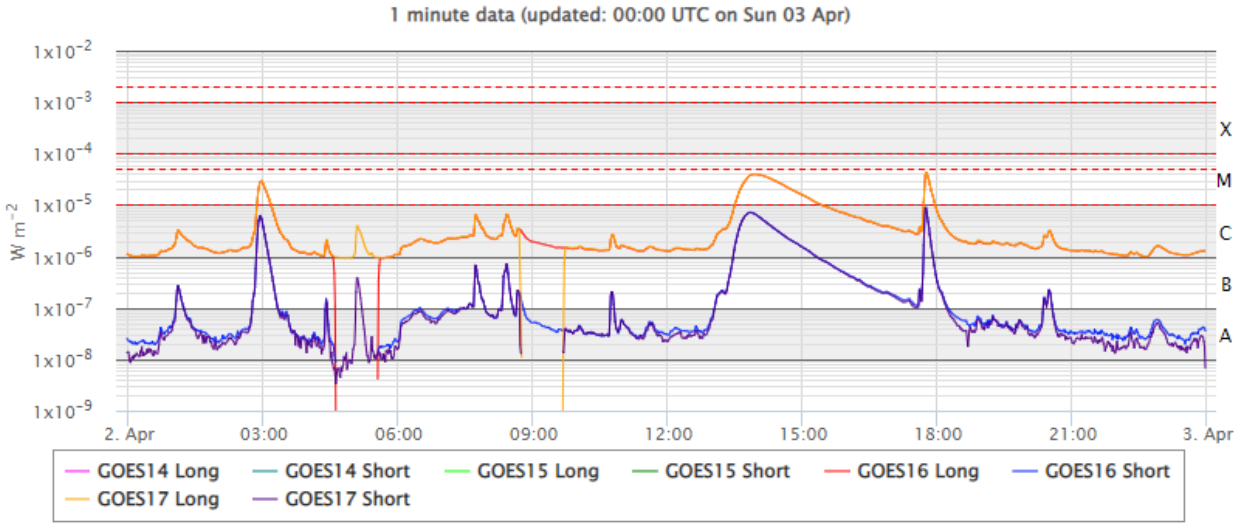
Radio Blackouts - X-Ray Flares:
Solar activity rose to Moderate in the past 24 hours, with three M-class flares, these from the three sunspot regions near the northwest limb.

Solar activity has been dominated in the past week by the large and active AR2975, which is now starting to rotate off the northwest limb, along with similarly large but less active AR2976, and now a newly-developed region inbetween them, AR2984. The development of AR2984 itself suggests this northwestern region is still a developmental area.

Near south centre disc are AR2978 and AR2981, both of which have developed further intermediate spots recently and contribute to the flare risk. Other spots are small and simple, although there is a new region rotating onto the southeast limb which cannot yet be classified. Overall, the flare risk is expected to decline through the coming four days as 2975, 2984 and 2976 all rotate off the disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	50	40	40
Very Active	R3 to R5 X Class	No	10	10	5	5

Figure 3: X-ray flare trace from GOES-16 showing 3 M-flares in the last 24 hours, all from the northwest corner of the disc.



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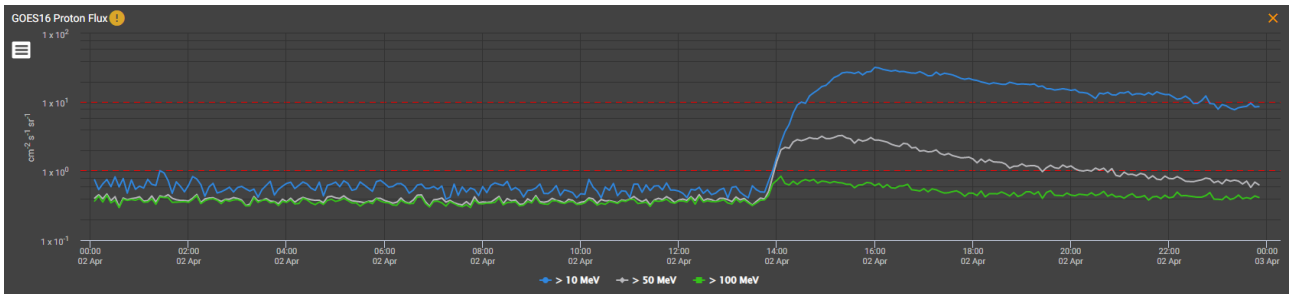
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (10MeV) measured at GOES-16 reached S1/Minor Storm levels after a long period M-flare from near the northwest limb. This is expected to gradually decline to background levels through Day 1 (03 Apr).

AR2975, approaching the northwest limb, has produced proton-rich flares and continues to have the potential for M- and perhaps low X-class flares. Although this is due to rotate off the disc by the end of Day 1, it will continue to provide a proton risk until it has been off the disc for at least a couple of days. Furthermore, there are a number of other potential flare sources on the disc, although two of these are also due to rotate off during Days 2 and 3 (04-05 Apr), but again will still provide a proton risk until well off the disc.

Two further larger regions near south centre disc, AR2978 and AR2981, will both maintain a smaller level of proton risk one the northwestern regions have rotated off.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	80	15	10	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 proton flux, showing 10MeV protons reaching S1/Minor Storm levels today, now just below the S1 threshold.



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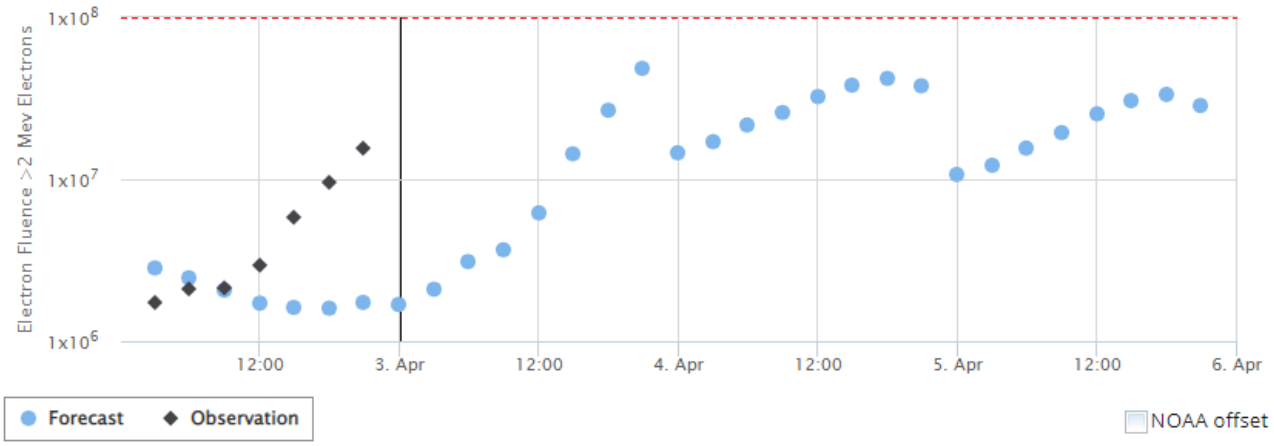
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux, as observed by GOES-16 at GEO, reached a late peak just above High levels during the UTC day on 02 April. The current elevated wind speeds are likely to have given some electron charging, with an increase in flux levels expected through the next few days. It is probable that electron flux will reach High levels at the diurnal peaks through the next four days.

The associated 24-hour fluence will start below the Active (1e8 integrated pfu) threshold, but it is on a rising trend. With an increase in flux levels predicted, it seems likely that fluence will continue to rise. There is a chance that Active levels may be reached on Day 1 (03 Apr), becoming likely by Days 3 and 4 (05-06 Apr).

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	50	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 5: REFM showing a forecast increase in fluence levels. This seems to be a good trend, although fluence levels seem likely to reach above Active during the coming four days.



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